HAYSPUR FISH HATCHERY
ANNUAL REPORT

October 1, 1989 to December 31, 1990

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INTRODUCTION

Hayspur Fish Hatchery is a broodstock and production facility for rainbow trout Oncorhynchus mykiss. The hatchery is located in Blaine County on Loving Creek, approximately 18 miles southeast of Hailey, Idaho. Egg production to meet the needs of five resident hatcheries has become a priority since the 1989 completion of Phase 1 of the renovation plan.

Water sources include: 1) Hayspur Spring 3.0 cfs to 5.0 cfs at 53°F (11.6°C); 2) artesian wells 2.5 cfs at 53°F (11.6°C); 3) spring seepage into brood pond 1.5 cfs at 53°F (11.6°C); and 4) Loving Creek 8 to 22 cfs ranging from 33° to 73°F (.55° to 22.7°C).

Fish culture apparatus consists of a hatchery building containing 18 single Heath incubator stacks and 20 early rearing raceways. Outside apparatus includes six small fingerling raceways, six large production raceways, eight covered circular ponds, and an earthen brood pond.

The hatchery is staffed with three permanent employees (Fish Hatchery Superintendent II, Fish Hatchery Superintendent I, and Fish Culturist) and seven months of temporary time (Bio-Aide).

HATCHERY IMPROVEMENTS

Improvements to the hatchery this year were the following:

1. Construction of garage and storage area for Superintendent I residence.

2. Domestic water line altered to draw water prior to packed column.

3. Air spawning system assembled, plus crowd racks and a portable spawning platform constructed for use in circular ponds.

4. Hatchery early rearing tanks repainted, new screens built, and standpipes replaced.

5. Development of a broodstock management plan.

6. Replaced 1-ton pickup truck and snowplow system.

FISH PRODUCTION

During Brood Year 1989, the Hayspur rainbow trout broodstock produced 7,541,139 eggs (Table 1). Fecundity averaged 2,653 eggs per female for 2-year-olds and 3,179 eggs per female for 3-year-olds and older. Eye-up rates for 2- and 3-year-old fish averaged 81.2% and 87.6%, respectively, with an overall

Table 1. Brood Year 1989 spawning information (R9).

Date	Lot #	females	Eggs/ ounce	Green eggs	Eggs/ female	Eyed #	% eyed	# eyed eggs shipped
10/05	1	51	290	158,751	3,173	137,333	86.5	137,333
10/15	2	36	290	86,940	2,610	73,511	84.6	73,511
10/16	SPF1	43	381	107,774	2,480	40,449	37.5	40,449
10/17	3	58	290	170,735	3,180	148,029	86.7	0
10/18	SPF2	98	381	256,504	2,775	177,580	69.2	177,580
10/19	SPF3	54	381	132,366	2,554	86,206	65.5	86,206
10/20	SPF4	82	381	185,422	2,443	135,552	73.1	135,552
10/23	4	77	290	251,747	3,198	233,138	92.8	0
10/24	SPF5	71	318	200,266	2,481	138,803	69.3	138,803
10/26	SPF6	160	351	307,325	3,187	296,953	96.6	296,953
10/27	SPF7	157	264	580,760	3,313	403,750	69.5	403,750
10/30	SPF8	108	318	305,873	2,837	281,052	91.9	281,052
10/31	5	135	318	465,121	3,568	430,000	92.4	0
11/01	SPF9	85	318	259,857	2,865	232,303	89.4	232,303
11/02	SPF10	145	238	390,966	2,576	358,580	91.7	358,580
11/06	SPF11	151	318	364,109	2,455	332,258	91.2	332,258
11/07	6	115	238	356,105	3,274	325,496	91.4	110,264
11/08	SPF12	97	318	259,753	2,517	223,642	86.1	223,642
11/09	SPF13	133	290	386,986	2,442	355,696	92.0	355,696
11/13	SPF14	92	290	268,281	2,660	224,687	83.8	224,687
11/14	7	95	238	272,016	3,632	237,777	87.4	237,777
11/15	SPF15	74	351	208,593	2,959	183,593	88.0	183,593
11/16	SPF16	143	351	463,682	2,120	404,166	87.2	404,166
11/20	SPF17	151	290	451,541	2,442	288,960	64.0	288,960
11/21	8	98	238	358,625	3,796	301,063	84.0	301,063
11/30	9	79	216	227,500	2,963	190,000	83.5	0
12/19	10	21	238	63,541	2,402	36,041	56.7	36,041
Total:		2,609		7,541,139		6,276,618	83.2	5,060,219

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average of 83.2% for all eggs taken. A total of 6,276,618 eyed eggs were produced. Eyed-eggs were shipped to five resident fish hatcheries, including: American Falls, Grace, Hayspur, Hagerman, and Nampa (Table 2).

The Hayspur rainbow trout broodstock produced 8,600,973 eggs during Brood Year 1990 (Table 3). Fecundity averaged 2,467 eggs for 2-year-olds, 4,437 eggs for 3-year-olds, and 3,099 eggs for 3-year-olds and older. Overall eggs per female averaged 3,111 eggs. Eye-up rates for 2-year-old fish were 80.7%. Three-year-old and older broodstock eye-up rates were 78.4% and 68.3%, respectively. All together, eye-up rates averaged 76.9% for the year. Eyed eggs produced this year totaled 6,610,958. American Falls, Grace, Hayspur, Hagerman, and Nampa hatcheries received eyed-eggs (Table 4).

Also in 1990, a population of Skanes or Gloyd Springs Kamloop trout was spawned at Hayspur. A total of 744,767 eggs were taken from a 2-year-old population (Table 5). Fecundity averaged 1,970 eggs per female. Eye-up rates averaged 40.4% (Table 5). Eyed eggs produced and shipped to Hagerman Hatchery totaled 300,590 eggs (Table 6).

Production goals for Hayspur Fish Hatchery were met with 645,877 rainbow trout being produced (Table 7). Fingerling production goals were changed from spring release to fall release. Magic Reservoir was stocked with 375,024 fall fingerling (3 to 6 inches) weighing 21,950 pounds (Table 8). The Big Wood, Little Wood, and upper Salmon River drainages were stocked with 270,853 catchables weighing 104,692 pounds (Table 9). Mackay Reservoir was stocked with 5,000 excess catchables.

As per Bureau directive, a 10-fish sample from each of six catchable production raceways was evaluated for fin quality. Five fins (two pectorals, two pelvics, and one dorsal) were assigned a value up to 20% for a complete fin. The sample group yielded an overall fin quality "index" of 73%. Most affected fins were the dorsal and pectoral fins.

BROODSTOCK

Hayspur Strain Rainbow Trout (R9)

Strain evaluation studies have demonstrated a relatively high rate of return-to-the-creel for Hayspur strain rainbow trout compared to other available strains. In consideration of the performance of the Hayspur strain, a 2.4 million dollar project to expand egg production capabilities was initiated in 1989, with completion of the first of four phases of construction. Phase 1 included completion of eight 24-foot diameter circular ponds with grain bin covers, a headbox for gathering and degassing water from the Hayspur Spring and well #2, and appropriate pipes and valves to control water flow to existing and new apparatus.

Table 2. R9 eyed eggs requested and produced Brood Year 1989-90.

Hatchery	Requested	Shipped	% goal achieved
Hagerman	2,950,000	3,024,107	102
Hayspur	1,000,000	**1,276,399**	121
American Falls	750,000	742,852	99
Nampa	650,000	889,313	136
Grace	0	404,166	*
	5,350,000	6,336,837	117

* eggs in excess of requests

HAYSPR90

Table 3. Brood Year 1990 spawning information (R9).

Date	Lot	# females	Eggs/ ounce	Green eggs	Eggs/ female	Eyed	% eyed	# eyed eggs shipped
10/04	SPF1	20	290	80,203	4,010	58,918	73.5	0
10/10	SPF2-2	28	454	67,000	2,392	46,250	69.0	46,250
10/12	SPF3	40	290	156,854	3,921	123,243	78.6	123,243
10/12	SPF4-2	36	454	93,131	2,586	61,086	65.6	61,086
10/12	SPF5-T	32	290	135,277	4,227	96,666	71.5	96,666
10/17	SPF6	69	290	298,310	4,323	255,750	85.7	255,750
10/17	SPF7-2	25	423	64,981	2,599	60,416	93.0	60,416
10/18	1	25	238	64,548	2,581	60,263	93.4	60,263
10/19	SPF8-2	39	454	100,800	2,584	81,200	80.6	81,200
10/19	SPF9-T	34	290	155,862	4,584	131,538	84.4	131,538
10/23	2	41	238	96,233	2,347	88,125	91.6	0
10/24	SPF10-2	37	423	87,133	2,354	78,800	90.4	78,800
10/24	SPF11	81	264	362,086	4,470	285,244	78.8	285,244
10/25	SPF12-2	42	381	101,951	2,427	82,692	81.1	82,692
10/25	SPF13-T	49	264	215,730	4,402	202,804	94.0	202,804
10/30	SPF14	18	290	79,486	4,415	39,743	50.0	39,743
10/30	SPF15-2	68	423	152,222	2,238	132,592	87.1	132,592
10/31	SPF16	52	290	229,863	4,420	190,595	82.9	190,595
10/31	SPF17-2	78	381	191,132	2,450	172,243	90.1	172,243
11/01	SPF18-T	29	290	149,771	5,164	131,951	88.1	131,951
11/01	3	127	264	406,341	3,199	331,097	81.5	331,097
11/06	SPF19-2	87	381	219,187	2,519	156,607	89.7	196,607
11/06	4	91	290	331,238	3,639	279,875	84.5	0
11/07	SPF20	55	290	256,360	4,661	104,634	40.8*	104,634
11/08	SPF21-2	82	381	205,713	2,508	191,785	93.2	191,785
11/08	SPF22-T	43	290	203,750	4,738	181,125	88.9	181,125
11/13	5	116	252	384,825	3,317	111,360	28.9*	0
11/14	SPF23-2	120	318	297,930	2,482	237,068	79.6	237,068
11/14	SPF24	58	238	252,583	4,354	179,047	70.9*	179,047
11/15	SPF25-2	125	381	289,488	2,315	269,655	93.2	269,655
11/15	SPF26-T	34	264	161,181	4,740	141,951	88.1	141,951
11/16	SPF27-2	286	423	601,303	2,102	296,956	49.4*	296,956
11/16	6	38	238	152,320	4,006	26,666	17.5*	0
11/19	SPF28-2	97	381	213,213	2,198	193,035	90.6	193,035
11/19	SPF29	24	264	106,025	4,417	82,179	77.5	82,179
11/20	7	101	264	267,034	2,643	224,230	84.0	224,230
11/21	SPF30-2	78	381	181,880	2,331	168,214	92.5	168,214
11/21	SPF31-T	21	290	99,542	4,740	88,292	88.7	88,292
11/23	SPF32-L	4	238	18,589	4,647	10,714	57.6	10,714
11/27	8	55	264	172,972	3,144	131,875	76.2	0
11/28	SPF33	40	276	158,375	3,959	128,875	81.4	128,875
11/29	SPF34-2	77	351	186,813	2,426	171,296	91.7	171,296
11/29	SPF35-T	33	264	135,525	4,106	120,789	89.1	120,789
11/29	SPF36-2	62	381	211,774	3,415	195,740	92.4	195,740
12/04	9	68	290	204,439	3,005	167,773	82.1	0
Total:		2,765		8,600,973		6,610,958	76.9	5,746,365

* Not included in overall eye-up percentage due to upweller problems.

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Table 4. R9 eyed eggs requested and produced Brood Year '90/'91.

Hatchery	Requested	Shipped	% goal achieved
Hagerman	2,950,000	3,701,739*	125
Grace	1,000,000	1,049,814	105
American Falls	700,000	718,200*	103
Hayspur	750,000	864,593	115
Nampa	600,000	718.071*	119
	6,000,000	7,052,417	118

* some eggs shipped after Dec. 31, 1990

Note: Small quantities of eyed eggs were transferred to the Nature Center (Boise) and Oxbow Hatchery.

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Table 5. Brood Year 1990 spawning information (K1).

Date	Lot #	# females	Eggs/ ounce	Green eggs	Eggs/ female	Eyed #	% eyed	# eyed eggs shipped
10/22	1	96	351	199,469	2,078	51,612	25.8	51,612
10/29	2	16	318	30,719	1,920	21,364	69.5	21,364
11/05	3	10	381	25,773	2,577	21,826	84.7	21,826
11/13	4	8	290	18,510	2,314	14,571	78.7	14,571
11/18	5	9	381	19,297	2,144	8,428	43.7	8,428
11/26	6	7	454	17,206	2,458	11,956	69.5	11,956
12/04	7	192	454	320,961	1,672	99,805	31.1	99,805
12/12	8	37	381	66,037	1,785	37,421	56.7	37,421
12/19	9	16	381	21,538	1,346	16,851	78.2	16,851
12/31	10	18	381	25,257	1,403	16,756	66.3	16,756
Total:		409		744,767		300,590	40.4	300,590

Table 6. K1 Eyed eggs requested and produced Brood Year '90/′91.

Hatchery	Requested	Shipped	% goal achieved
Hagerman	1,000,000	338,506	33.9

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Table 7. Fish requested and produced October 1, 1989 to December 31, 1990.

Species & size	Production goal	Actual production	Percentage of goal achieved
R9 3 " +	300,000	375,024	
R9 8-10 " +	268,900	270,853	125.0
		645,877	

Table 8. Hayspur Fish Hatchery fingerling production October 1, 1989 to December 30, 1990.

Species	Source	Eyed eggs	Yield	% survival	Cost/ 1,000	Cost/ pound	Comments
R9	Hayspur	1,216,399	375,024	68.9	188.04	7.006	319,802 held for catchables
			143,835				excess fry transferred to Hagerman

Table **9.** Hayspur Fish Hatchery catchable production October 1, 1989 to December 30, 1990.

Species	Source	Eyed eggs	Yield	Yield pounds	% survival	Plant site	Cost/ 1,000	Cost/ pound
R9	Hayspur	355,088	270,853	104,692	76.3	Wood Salmon R.	582.23	1.506

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Within a week of Phase 1 construction completion, Hayspur personnel installed drop logs, stand pipes, and inlet screens in the eight circular ponds. In 1989, 4,832 Specific Pathogen Free (SPF) 2-year-old broodstock, selected at Hayspur and reared at American Falls, were transported to the circular ponds at Hayspur. Many of these fish were spawned within 24 hours of arriving.

An air-spawning system was completed with the design copied from Wes Orr at Ennis National Fish Hatchery. Air spawning advantages were less time spent spawning, reduced stress on fish, easier on the personnel, nearly all eggs are obtained, very few broken eggs, and egg quality preserved with inexperienced personnel.

Saline fertilization using a 1% solution or 28.3 grams of salt/gallon of spring water and Argentyne water hardening with 1:100 solution were utilized. Eggs were measured by the Von Bayer method and set in Heath stack trays at 96 ounces for incubation. After eye-up (17 days), the eggs were shocked by siphon method. Within 24 to 48 hours, eggs were picked with a Jensorter model JH and then hand picked. The eggs were enumerated by displacement method and transported to the receiving hatchery in Whitco boxes or coolers.

During the summer of 1990, a broodstock management plan was drafted. The goals were:

1) To maintain the genetic diversity of the Hayspur strain of rainbow trout.

2) To provide adults for one female by one male pairings to produce broodstock replacements for introduction into the SPF population and earthen pond.

3) To generate six million eyed eggs for state programs.

4) To use all reasonable effort to prevent transfer of IPN virus to the SPF portion of the Hayspur broodstock program.

5) To develop a photoperiod scheme to alter spawning time to generate eggs as requested.

In September 1990, two circular ponds were loaded with 2,700 2-year-old Hayspur rainbow reared at Nampa Fish Hatchery. Four circular ponds contained 3-year-olds. Two ponds were loaded with 2-year-old Skanes/Gloyd Springs Kamloop trout derived from production lots at Nampa and American Falls hatcheries.

Results of the broodstock program have been encouraging. Genetic diversity was evaluated by Rick Williams at Boise State University. A heterozygosity rate of 6.4% was reported in a sample of 2-year-old (BY 88) broodstock replacements, indicating "good to excellent" variability (Rick Williams personal communication). Egg quality, quantity, and time frames have been acceptable to the managers involved.

HAYSPR90

FISH HEALTH

Brood Year 1989-1990 represents the third year of production of catchables free of the whirling disease pathogen. The management practice of rearing production fish in spring water to 3 inches in length prior to moving into large raceways supplied by Loving Creek water is working. A mild winter and maintenance feeding during winter alleviated the historically chronic outbreaks of coldwater disease and Gyrodactylus species. Some of the largest catchables in years were stocked in 1990.

Drought effects of low flows, high temperatures (73°F), low dissolved oxygen levels, and turbid waters provided harsh summer rearing conditions. These factors led to a few minor outbreaks of **BGD,** which were treated effectively with Chloramine-T. Water from the brood pond was pumped into the large raceway headbox to augment flows and decrease temperatures. This pumping is less than a desirable practice, as whirling disease agent Mvxobolus (Myxosoma) cerebralis was detected in the earthen pond population (1/5 pools). Whirling disease was not detected in the exposed catchable population.

Pairings for SPF broodstock replacements totaled 85 in 1989 and 102 in 1990. Ovarian fluids from females and spleen, kidney, and pyloric caeca samples from males were tested at Eagle Fish Health Lab. It should be noted, all adult fish were negative for IPN as well as other pathogens. Progeny from these pairings were split into two groups. One group was transported to Nampa Fish Hatchery for rearing in 59°F water. The other group remained in isolation rearing as back-up and as replacement broodstock for the earthen brood pond at Hayspur.

PUBLIC RELATIONS

A new and popular fishery at Gaver Lagoon was enjoyed by a lot of folks, including kids and disabled. On opening weekend of fishing season, about 500 to 800 people were observed fishing Gaver Lagoon. Also, Free Fishing Day brought out assorted anglers.

Approximately 7,500 people visited the hatchery, stayed at the campground, and/or fished **Gaver** Lagoon or Loving Creek on the hatchery premises. Other campground usage included hosting a national level field trial event and a Good Sam's convention.

An outdoor picnic for American Fisheries Society bureau chiefs was hosted. Tours of the newly-constructed broodstock ponds were given.

Television coverage (KIVI and KMVT Channel 11 TV), radio commentaries (KLIX, KTFI, KEEP,and KART), articles and photos {Idaho State Journal and Wood River Journal) featured Hayspur spawning events. Also, tours and classroom presentations were given to Bellevue Elementary, Hailey Junior High, and Hemingway school in Ketchum.

HAYSPR90

Hayspur personnel performed fish salvage operations on the Big Wood below the Glendale diversion and below Magic Reservoir in cooperation with regional fisheries staff and Friends of the Big Wood. Personnel demonstrated spawning techniques, including air spawning, at Henrys Lake Hatchery.

SATELLITE PROJECTS

Baker Lake Trapping and Spawning

Hayspur personnel operate a golden trout Oncorhynchus aguabonita trapping and spawning project in the upper Big Wood drainage at Baker Lake. Baker Lake (elevation 8,796 ft) is a 12 surface-acre alpine lake. The lake is reached via a 1 1/4-mile hike from the trailhead at the end of Baker Creek Road. Baker Creek Road is located approximately 15 miles north of Sun Valley.

The lake was monitored for "ice off," which occurred on June 10, 1990. Trapping operations started on June 12, 1990 and ran to June 27, 1990. A total of 33 golden trout (12 females and 21 males) and 154 Henrys Lake cutthroat Oncorhvnchus clarki were trapped. No eggs were taken this season as no ripe golden trout females were available.

To reduce competition and chances of genetic introgression, the cutthroat were transported below a natural migration barrier downstream and released. Cutthroat biomass removed was estimated at 91.4 pounds.

Data collected in 1989 recorded a mean length of 9.12 inches or 232 mm for golden trout trapped. Mean length of golden trout trapped was 8.56 inches or 217.5 mm for 1990. Length data in 1990 included 2-year-old fish from 1989 introduction as well as adults from the original 1987 introduction. Fish 10 inches (270 mm) to 12 inches (310 mm) were recorded in 1990. This suggests the inch of annual growth demonstrated in 1989 remains valid.

On July 6, 1990, 654 golden trout fingerling (27/pound) were stocked into Baker Lake. These goldens were adipose-clipped for tracking purposes. Transport was by truck to near the trailhead and helicopter via "bambi bucket" to the lake. Observations by Hayspur personnel indicated a successful outplant.

Improvements to the trapping operation at Baker Lake in 1990 included:

1. Reconstruction of portable trap.
2. Suggestion of 21-day treatment with Terramycin at Ashton Hatchery prior to outplant to address observed symptoms consistent with coldwater disease.
3. Development of a management plan.

4. Pursue efforts to obtain golden trout from varied sources; preferably South Fork Kern River stock, Cottonwood Lakes, or other western states.

Production of Triploid Fish

This year, several species of fish were heat-shocked to produce "trophy" size fish by induction of triploidy. The induction of triploidy (three sets of chromosomes) produces a sterile fish that may live longer and should not reach sexual maturity. This longer life expectancy and extra energy from not producing gonads allows the fish to grow larger.

Three species of fish were heat-shocked 10 to 20 minutes after fertilization for 10 to 20 minutes at 26.0^{0} or 28.5°C, respectively (Table 10). Triploid induction rates and survival to eyed eggs were poor for all the species (Table 10). The low induction rates for Henrys Lake hybrids (C3 x R6) resulted in the fish not being stocked into Warm Lake. Both the chinook (1,000 fish) and kokanee (600 fish) were stocked into Coeur d'Alene Lake.

Blood samples were taken from each species and sent to Dr. Gary Thorgaard at Washington State University, Pullman, Washington, for ploidy analysis. Unfertilized gametes from 9 females and 12 males taken at Hayspur were traded for lab time and analysis.

Loving Creek Cooperative Project

Loving Creek, after discharge from the hatchery, flows through a channelized section for approximately 1,500 feet. A cooperative project between the Fly Fishers of Idaho, the 321st Engineering Battalion from Twin Falls, and the IDFG was developed to alter the course of Loving Creek to a meandering channel. The meandering channel will follow the old course of Butte Creek, which is evidenced by a narrow stream course bordered by cattails and willows. A plan was developed including blueprints, Environmental Protection Agency (EPA) permit, planning and zoning approval, and a private contractor sign-off contract completed. Due to a change in priorities, the Engineering battalion was unable to perform the excavation. Governor Andrus was approached by the Fly Fishers and, subsequently, asked the IDFG Engineering Bureau to perform the excavation project. Start-up for this project is scheduled for spring of 1991. High catch rates and "trophy" regulations are in place for this soon to be enhanced fishery.

Sawtooth Hatchery Catchable Redistribution

With a goal to make fishing better, reduce transportation costs, and improve public satisfaction in the Stanley basin/upper Salmon River area, a catchable redistribution project was initiated. Sawtooth Hatchery received a total of 64,594 catchable rainbow trout from Hayspur Hatchery. Small accessible

Table 10. Results from heat shock experiments in 1989.

Species	TAF	Minutes shocked	Temp (C)	tested	% 3N	% eyed	Green eggs
chinook	10	10	28.5	28	71	19.7	12,429
kokanee	10	10	28.5	27	62	23.0	28,950
CTxRT	10	10	28.5	22	27	63.5	133,325
CTxRT	20	20	26.0	23	17	40.8	120,717

TAF = time after fertilization
CTxRT = Henrys Lake cutthroat x rainbow trout

lakes, Salmon River tributaries, and the mainstem Salmon River were stocked by Sawtooth personnel.

Perception of the program by the anglers, public, and local businessmen in the Stanley area was deemed excellent. This effective program will continue in 1991.

Yellowbelly Lake Renovation

Hayspur Fish Hatchery personnel participated in the rotenone treatment of Yellowbelly Lake to provide an environment for a westslope cutthroat Oncorhynchus clarki lewisi broodstock and subsequent spawning project. Hayspur personnel were involved in preparation (equipment hauling, live box and fish placement, and construction of detoxification system at outlet), application of rotenone, operation of detoxification station, monitoring live boxes, and follow-up hauling of rainbows for live boxes.

Feed experiment

A 90-day feed experiment was conducted at Hayspur Hatchery in the spring of 1989. Fish ranged in size from 123 fish/pound to 187 fish/pound at the start of the study. Water flow, fish density, and water temperature (53°F) was the same for each tank. Fish were held in eight inside vats (four replicates of each group) and two outside small raceways. The two types of feed used in the study were Biosponge (#3 and #4) and Silvercup (#3 and #4). Fish were fed according to the manufacturer's suggested feed conversion for that size feed. All other factors (body weight fed, daily length increase, and daily mortality) remained constant throughout the feed experiment.

Feed was weighed out every day. Vats and raceways were cleaned daily with cleaning time and mortalities recorded. Pound counts were taken at the end of each month and data was tabulated to adjust feeding rates. The results from the feed experiment were tested by one-way analysis of variance on fish size, weight gain, dead fish, and time cleaned.

No significant differences ($P < .05$) were observed between Biosponge and Silvercup feed for fish size, weight gain, dead fish, and time cleaned (Table 11.) However, Silvercup feed had a better feed conversion, better survival rate, and lower cost per pound (Table 11). Biosponge feed had less cleaning time for outside small raceways (Table 11.)

HAYSPR90

Table 11. Results from 90-day feed study comparing Biosponge and Silvercup feed.

Feed type	Fish size	Feed fed	Wt gain	Feed conversion	Cost /lb	Dead fish	% survival	No. fish end	Clean time (min)
Biosponge	38.9	2702	2371	1.13	.393	2489	98.5	165,948	455
Silvercup	31.1	3185	3337	.95	.314	1434	99.1	165,336	910

Clean time is only for small outside raceways 3 and 4.

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